VI.—*Notes from the St. Andrews Marine Laboratory (under the Fishery Board for Scotland).*—No. X. By Prof. M'Intosh, M.D., LL.D., F.R.S., &c.

[Plate VIII.]

1. On Abnormal Hydromedusæ.
2. On the Occurrence of the Ctenophores throughout the Year.
3. On a Heteropod (*Atlanta*) in British Waters.

1. *On Abnormal Hydromedusæ.*

Two examples of abnormal Hydromedusæ having precisely similar structure were procured by the midwater-net in August 1886 in St. Andrews Bay. They occurred amidst swarms of *Thaumantias*, *Bougainvillia*, *Oceania*, *Stomobrachium*, *Cyanea*, *Aurelia*, *Pleurobrachia*, *Beroë*, and other forms. A brief description of these was communicated to the Birmingham Meeting of the British Association the same year *, it being pointed out that so far as specific characters were present they seemed to be abnormal forms of Forbes's *Thaumantias melanops*. The latter, however, was only half an inch in diameter, whereas both of the specimens described were about 5 inches in diameter.

These large examples (Plate VIII. fig. 1) were readily distinguished by the presence of a simple pale cross of the reproductive bands along the radial canals, the bands, moreover, meeting in the centre of the disk, which was devoid of a manubrium. The disk had the ordinary shape, viz. moderately convex dorsally, somewhat flattened ventrally, and presented no novelty in the microscopic structure of its hyaline tissue. The margin is surrounded by a closely arranged series of tentacles of considerable length, each tapering from base to apex, and furnished with a single small black pigment-speck at the base. The pigment-granules show no special differentiation. Within the bases of the tentacles is the velum.

The reproductive bands, *g*, begin a short distance within the margin, and extend along the radial canals right across the disk in each case, thus forming a conspicuous cross. Moreover, the uniformity of their diameter is one of the most characteristic features, no ordinary *Thaumantias* resembling them in this respect, the nearest perhaps being *Thaumantias pilosella*.

* Report Brit. Assoc. 1886, pp. 710, 711.

These bands are somewhat regularly folded or lobulated at the margin, and have a pale grey or dull whitish colour. The elements (probably male) were not much developed, the minute constituent cells being finely granular. The bands met in the centre of the disk, so that there was little room for doubt in regard to the absence of manubrium and mouth.

A similar condition to the foregoing was observed in *Tima Bairdii*, Johnst., one of those characteristic forms found long ago by Edward Forbes on the West Sands at St. Andrews, a locality which the pen and pencil of this genial naturalist would alone have made classic ground to the marine zoologist.

In the midwater-net of the 28th September a small example of *Tima Bairdii* measuring about $\frac{5}{8}$ inch across (Pl. VIII. fig. 2) presented an unusually flattened shape, from the absence of the large manubrium. Moreover, the radial canals, *r c*, with the reproductive bands, which had a minutely granular structure, closely approached each other in the centre of the disk, so that a small circular area only intervened. Careful investigation of the latter area showed that the hyaline ectoderm of the Medusa was continuous in this region, so that no trace of an aperture existed. The radial canals ceased at the margin of the area, one or two, indeed, having a slight expansion before terminating. This area, although solid, corresponded with the gastric region in connexion with the radial canals, and therefore in this respect differed from the preceding examples of *Thaumantias*.

In the case just narrated (*Tima Bairdii*) the specimen had by no means reached the average size of the period; but this need not be held as indicating that it was stunted from the abnormality of its alimentary apparatus. In the large *Thaumantias* first mentioned it is apparent that without a trace of manubrium or mouth the species had not only attained the ordinary limit of growth, but had largely exceeded it. So far as our experience goes, no other *Thaumantias* in British waters attains such dimensions, though the digestive apparatus exists in full perfection. The instance of the *Thaumantias* therefore is more remarkable than Mereschkowsky's, for in his small species (*Bougainvillia*) the abnormal specimens were "only a little exceeded in size by the normal adult individuals," that is to say, those without manubrium and mouth were somewhat less.

In his "Remarks on a Mode of Nutrition among the Hydromedusæ of the Russian seas" C. Mereschkowsky * gives an

* Ann. & Mag. Nat. Hist. ser. 5, vol. iii. pp. 177–181, pl. xx. (1879).

account of certain forms of *Bougainvillia paradoxa* from the White Sea which were totally devoid of a manubrium, and this was the more readily noticed from the absence of the dark red coloration usually characterizing it. Careful search for the manubrium revealed no trace, the whole gastro-vascular system consisting of a circular and four radial canals, without stomachal dilatation or communication with the exterior. The endodermic cells of the canals showed active ciliary motion, but no food could reach them. These specimens, which had attained about half a centimetre, had therefore reached nearly (but not quite) full size without being nourished in the ordinary way. Another species belonging to the same genus was occasionally found in a similar condition, the four radial canals meeting without forming a stomachal cavity and the mouth being entirely absent.

Mereschkowsky considers it is clear that such Medusæ live, and increase in size from a minute embryo without digestive organs, and even apparently without nourishment. Yet the latter notion cannot be accepted, and after searching through all the possible means he comes to the conclusion that "the Medusa can nourish itself by means of its ectoderm by absorbing the organic material dissolved in the sea-water." He cites the case of certain sponges which nourish themselves upon organic matter dissolved in sea-water, and also by means of their ectoderm, and thinks it possible that the Medusa can dispense with its entoderm and yet live and attain nearly its normal size. The ectoderm therefore in such cases fulfils the function of the entoderm, *i. e.* extracts and assimilates the organic matter dissolved in sea-water. He never found solid particles on the surface of the Medusa, and he is of opinion we have really to do only with organic matter dissolved in sea-water.

The theory broached by Mereschkowsky is not altogether new, but has formerly been brought forward to explain the nourishment of marine animals. Thus the naturalists of the 'Porcupine' Expeditions of 1869 and 1870 held that the marine Rhizopoda, like the Entozoa, had the power of absorbing organic matter or "diffused protoplasm" in sea-water. Moreover there is this feature in common with the abnormal Medusæ, viz. that both are devoid of a mouth. The same views therefore would equally apply to both. As formerly shown*, the question indeed is a wide one, and the remarkable tenacity of life exhibited by certain marine animals confined in pure sea-water lends some countenance to the notion.

* Ann. & Mag. Nat. Hist. ser. 4, vol. ix. p. 1 (1872).

However, as a rule mouthless marine animals are provided with certain definite modes of sustenance other than the mere imbibition of sea-water. Thus larval fishes devoid of a mouth have a yolk-sac, and protoplasmic animals either surround the food-particles with their bodies or place themselves in actual contact with them. The Hydromedusæ are generally somewhat voracious forms, even the smallest attacking animals much larger and higher in the scale than themselves. It is possible therefore that such mouthless Medusæ may, by contracting the disk, fold themselves over prey of various kinds, and thus directly absorb nourishment through the ectoderm. They certainly show remarkable eagerness and mobility in feeding. No species is more conspicuous in this respect than *Lizzia octopunctata*, which will permit itself to be dragged behind a *Sagitta* with the umbrella everted rather than loosen its hold. Again, L. Agassiz has seen half an *Idyia* (*Beroë*) close over a small *Bolina* and digest it, the cut edges overlapping its prey*. He seemed to think, indeed, that mutilated Discophora fared better in confinement than entire specimens.

The foregoing condition (in which the Medusæ are deprived of mouth and stomach) is the opposite of that described by Arnold Lang in *Gastroblasta Raffaeli*†, in which there are several stomachs and a variable number of apparently irregular tentacles and radial canals. None showed a truly radial arrangement. Many presented undulations in the outline and were ellipsoidal, indicating that they were in a state of division. They had sprung from others by the same method, the division commencing in each case at the margin, and it is probable that from very small parts an entire Medusa may be developed. If these Medusæ possess radial larvæ like *Eucope*, and propagate themselves by successive right angular divisions, we necessarily get a series of apparently irregular stages such as those described.

2. *On the Occurrence of the Ctenophores throughout the Year.*

Louis Agassiz considered the Ctenophores in general as annual animals, laying their eggs in the water in the autumn and then dying, the young brood making its appearance in the spring. He watched them on the shores of Massachu-

* Contrib. Nat. Hist. United States, vol. iii. p. 173.

† Jenaische Zeitschr. vol. xix. (1866). For this reference I am indebted to Dr. Scharff, of the Museum of Science and Art, Dublin.

setts for twelve successive years, and invariably found that in the earlier part of the summer the majority were small and not yet filled with eggs, as they are later in the season. The largest specimens, he adds, are always seen during the last summer months, and all disappear after the autumnal gales.

On the eastern coast of Scotland the most abundant Ctenophore at the beginning of the year, that is in January, is *Pleurobrachia*, which frequents the lower parts of the water, as demonstrated by the use of surface-, midwater-, and bottom-nets. This to a certain extent had long been known, for it is more than thirty years since the late Prof. G. E. Day exhibited to his class at St. Andrews in December living specimens gathered on the West Sands by Miss Otté. Moreover, the presence of small as well as large examples in the nets indicates that the ranks are being gradually recruited as well as by-and-by supplanted by the younger forms. There is little evidence of a general destruction of the adult forms at a given period.

The irregularity in size of those procured in January in all probability arises from the length of time during which spawning is carried on. The species continues in great profusion in February, and free (pelagic) ova were not uncommon—similar features characterizing the southern waters, as at Sheerness-on-Sea *, at this time. In March it was as plentiful both in the midwater- and bottom-nets, though the majority of the examples were small, a few, however, reaching $\frac{3}{4}$ inch in long diameter. Many minute young abounded in the trawl-like bottom-net towards the end of the month.

Like the other pelagic Cœlenterates, *Pleurobrachia* became very prominent in the midwater-net in April; but the specimens were chiefly small. At the beginning of May the size of the hordes of small *Pleurobrachiæ* ranged from $\frac{1}{8}$ to $\frac{1}{2}$ inch in long diameter; but they were accompanied by many larger forms, the number of the latter showing an increase on the previous month, a condition in St. Andrews Bay that may, however, have been due to immigration from the offing. The larger forms were mature. The majority were captured by the midwater-net, so that they had frequented the deeper regions of the water.

In July ova, larvæ, and young of *Pleurobrachia* were common near the bottom of the water, and towards the middle of the month ova and larvæ appeared in the midwater-net and by-and-by at the surface, the diameter of the latter varying from 1 to 1·5 millim. In every haul of the midwater- and

* From observations kindly furnished by Mr. Shrubsole.

bottom-nets the species occurred, the larger being most plentiful in the former. Many ($\frac{3}{4}$ inch in diameter) seem to have shed their ova. Throughout August small examples from $\frac{1}{8}$ to $\frac{1}{2}$ inch were most abundant in the surface- and midwater-nets, while the free ova were in various stages, and many of the larvæ had only recently escaped. The very young forms presented the trumpet-like projection of the mouth, and with the ova were most plentiful in the bottom-nets. During September they swarmed in the surface- and midwater-nets, ranging from $\frac{1}{8}$ to $\frac{1}{2}$ inch in polar diameter, and they were accompanied by ova and larvæ. Only a few of the same size and some larvæ were captured at the bottom. The collections made in the midwater-net afforded a contrast with those obtained *e. g.* in midwinter, the great size and beauty of the species at the latter season being noteworthy. They became rare in the surface-net in October, but myriads, ranging from $\frac{1}{5}$ to $\frac{9}{16}$ inch, still frequented the midwater; while a few accompanied by ova and larvæ appeared in the bottom-nets. Only a very few *Pleurobrachiæ* were captured in the surface- and bottom-nets in November, but many of large size appeared in the midwater-net. In December they were found at the surface in considerable numbers from $\frac{5}{8}$ inch downwards along with ova; indeed, at no period of the year were finer examples obtained. They ranged from $\frac{5}{8}$ to $\frac{1}{6}$ inch. A few also occurred in the bottom-net. As the cold season advanced they had a tendency to seek the deeper parts of the water.

It is thus apparent that many of these Ctenophores (*Pleurobrachia*) spawn in summer and attain their maximum size the following year, the adults gradually disappearing after shedding their ova. At no period, however, is the water devoid of them, and throughout the greater part of the year small forms are mingled with the larger. In *Pleurobrachia*, therefore, as in certain fishes, the spawning-period is evidently extended, that is, some are early mature, others considerably later, so that great irregularity in size is found at any given period.

Large specimens ($3\frac{1}{2}$ inches) of *Beroë ovata*, Esch., occurred in midwater at the commencement of the year along with young, the former only being obtained in February. Very young forms, $\frac{3}{16}$ inch again, appeared in April, showing that some ova were probably shed late in autumn *. Examples of moderate size were occasionally captured in May, and, like *Pleurobrachia*, sometimes injured the postlarval fishes in the midwater-net. In June and July *Beroë* became more abundant

* At Naples the deposition of ova is given as from November till June (Mittheilungen Zool. Stat. Bd. viii. p. 390).

and reached the surface of the water towards the end of the latter month; but in this neighbourhood it seldom is seen in the enormous numbers characteristic of July in the Zetlandic area. Both young ($\frac{1}{4}$ inch) and adults in full maturity (4 inches) were procured in considerable numbers throughout August. The larger forms became less conspicuous in September and October, a distinct increase in size occurring during the latter month in the younger forms, which range from $1\frac{1}{2}$ to $2\frac{1}{2}$ inches. Large examples were observed in November in the deeper parts of the water, and some of moderate size in December. The species appears to spawn in July and August, and most of the adults would seem to perish in the autumn. *Beroë* is thus seldom absent from the neighbouring seas.

In a former number of this Journal* the occurrence of a third Ctenophore, *Lesueuria vitrea*, M.-Edwards, in great numbers in British waters was pointed out. Very little has been heard of it in European waters since Milne-Edwards first described it from the Mediterranean in 1841. This to some extent, however, appears to have arisen from confusion with other species. Thus that patient and keen observer, Sir John Graham Dalyell, whose merits can scarcely be too highly estimated, described and figured in 1848† a form called *Beroë bilobata*, which he associated with the *Eucharis Tiedmanni* of Eschscholtz, thus correctly appreciating the relationship of a species apparently identical with the present (*Lesueuria vitrea*). He procured eight small specimens in August and two larger, $1\frac{1}{2}$ inch, in the same month and in February, probably in the Firth of Forth. Michael Sars, again, found it somewhat later (1856) off the Norwegian coast.

Young *Lesueuriæ*, $\frac{5}{8}$ inch in long diameter, appeared in April, while in May they occurred in great numbers, indeed forming the most conspicuous feature in the pelagic fauna. In June they were almost as numerous, ranging from $\frac{7}{16}$ inch or less upwards, and mainly frequenting midwater. *Lesueuria* was not quite so frequent in July, but occasionally occurred in multitudes, both large and small examples being present in the midwater-net, the latter specimens being a little over 2 inches. Many at this time showed ova measuring ·016 to ·0083 inch. In August the average size is larger than in the previous months, though the numbers are less. Few were procured in September and October, but in November and December they were occasionally captured from $\frac{5}{8}$ to $1\frac{1}{2}$ inch in diameter. The older forms appear to spawn in July and gradually die

* Ann. & Mag. Nat. Hist., December 1888.

† 'Rare and Remarkable Animals,' ii. p. 254, pl. liv. figs. 4, 5, 6.

off, leaving the young to develop during the winter. Young and adult forms, however, occur throughout the summer and autumn, so that the spawning-period is probably extended. The great development of the lateral lobes of the oral region causes a near approach to the *Mnemia* (*Bolina*) *norvegica* of M. Sars.

All the Ctenophores are thus found in greater or less abundance throughout the year, and do not appear suddenly as young specimens and disappear as suddenly as adults.

3. *On a Heteropod* (Atlanta) *in British Waters.*

Two years ago (May 1887) the capture of *Clione* in considerable numbers in St. Andrews Bay formed a feature of the season, and one which has not been repeated since, though last year the water was persistently examined from January to December. The frequent investigations of the Bay, however, in 1888 brought to light, amongst other things, a small transparent univalve, like a finely fashioned shell of glass, containing its inhabitant. It occurred in the midwater-net opposite the Maiden Rock on the 5th September, along with a very rich and varied fauna, including *Actinotrocha* and *Appendicularia*. The specimen measured about $\frac{1}{12}$ of an inch, and the aperture of the shell rather more than half this length. It was not detected until immersion in spirit had taken place.

In outline (Plate VIII. fig. 3) the form agrees generally with that of *Atlanta*, such as figured by Souleyet in his fine atlas *, in having a glassy, compressed, nautiloid shell, with a narrow aperture and a prominent lip, which projects considerably beyond the posterior coil. In a lateral view, indeed, the aperture has a prominent and somewhat hooked prow (on the left in the figure), from which a double curve proceeds to the inner border. Two volutions and an incomplete third seem to be present.

When examined on edge (Plate VIII. fig. 4) the peculiarly compressed condition of the shell is evident, the widest part being at the posterior border of the lip, where it bends down to join the spire. So far as can be judged from the outline in this position, the posterior or whorled region of the shell is flatter than the anterior. Moreover the free edge of the shell is not keeled, as in so many of the foreign species, a flattened margin being present all round. It must be borne in mind, however, that this is probably a young example and that considerable changes may ensue during growth.

* Voyage autour du monde &c. sur la corvette 'La Bonite.'

The contracted and opaque condition in spirit prevents a satisfactory examination of the soft parts, but, as indicated in the outline (Plate VIII. fig. 3), three regions occur anteriorly. These probably correspond to the head, the fin, and the posterior division of the foot.

The occurrence apparently of an example of a group of mollusks formerly unknown in British seas is noteworthy. Hitherto they have been considered characteristic of the pelagic fauna of the more genial oceans, such as the Mediterranean and the warmer parts of the Atlantic and Pacific. All recent investigations however, tend to enlarge the area of truly pelagic types, and to raise the question whether temperature alone is the cause of the appearance and disappearance of such forms in our seas. It is true temperature appears to have a marked effect on the vertical distribution of certain types and the pelagic ova of fishes ; but in the case under consideration the influence of currents is probably of greater importance.

EXPLANATION OF PLATE VIII.

Fig. 1. Abnormal *Thaumantias*, devoid of manubrium and mouth. The reproductive bands meet in the centre. About natural size.

Fig. 2. Mouthless example of *Tima Bairdii*, the central region being imperforate.

Fig. 3. Lateral view of *Atlanta* from St. Andrews. × 31.

Fig. 4. View of the same on edge. The opaque central region is the mass formed by the contracted body of the mollusk. Similarly enlarged.

VII.—*Descriptions of new Species of Longicornia from India and Ceylon.* By Charles J. Gahan, M.A., Assistant, Zoological Department, British Museum.

[Plate VII.]

The present paper is in great part the result of my work upon a small collection of Longicornia made by G. F. Hampson, Esq., in the Nilghiri Hills, S. India, and kindly placed by that gentleman at the disposal of the British Museum. In the descriptions, however, I have not confined myself to species from the Nilghiris, but have included also species from other parts of India and Ceylon which had already existed unnamed in the British Museum collection.

Prionidæ.

Rhaphipodus subopacus, n. sp.

Capite prothoraceque nigro-fuscis : elytris fusco-brunneis, subopacis,